REMARKS/ARGUMENTS

Claims 23-28, 30, 31, and 33-57 are pending in this application. By this Amendment, Applicant amends Claims 31 and 34.

Applicant's counsel greatly appreciates the courtesies extended by the Examiner in the Personal Interview on November 4, 2009. In the Personal Interview, Applicant's counsel explained the differences between the present invention and the applied prior art (primarily, Itakura et al. (US 2002/0158459)). Applicant's counsel explained the differences between a boundary acoustic wave device and a surface acoustic wave device with reference to Fig. 11 in Irino et al.; "Zero Slope Temperature $SiO_2/LiTaO_3$ Structure Substrate for Stoneley Waves" (C Vol.J70-C No.7, July 1987, pp.1070-1075). Applicant has submitted herewith an Information Disclosure Statement in which Irino et al. and a partial English language translation has been cited.

In Fig. 11 of Irino et al., K_R^2 shows the electro-mechanical coupling coefficient of a Rayleigh acoustic wave which is propagated by energy that is concentrated on the surface of a substrate. That is, K_R^2 in Fig. 11 of Irino et al. shows the electro-mechanical coupling coefficient of a surface acoustic wave. K_S^2 in Fig. 11 of Irino et al. shows the electro-mechanical coupling coefficient of a Stoneley acoustic wave, which is propagated by energy that is concentrated at the boundary between two media. That is, K_S^2 in Fig. 11 of Irino et al. shows the electro-mechanical coupling coefficient of a boundary acoustic wave. In addition, Fig. 11 of Irino et al. shows the normalized thicknesses of the SiO_2 layer, H/λ, at which a surface acoustic wave is propagated and the normalized thicknesses of the SiO_2 layer, H/λ, at which a boundary acoustic wave is propagated

Fig 11 of Irino et al. shows that K_R^2 is primarily propagated when the thickness of the SiO_2 solid layer is relatively thin, and K_S^2 is propagated when the thickness of the SiO_2 solid layer is greater than a prescribed thickness. That is, the surface acoustic wave is propagated when the thickness of SiO_2 solid layer is relatively thin, and boundary acoustic wave is propagated when the thickness of SiO_2 solid layer is

relatively thick.

Paragraph [0105] of Itakura et al. discloses, "The thickness ts of the SiO_2 layer was varied in the range of 2.0 to 5.0 in kh2 by adjusting the sputtering time;" and paragraph [0106] of Itakura et al. discloses, "kh2 is a parameter to express the thickness of the SiO_2 layer in relation to the wavelength λ of the fundamental wave of the second mode of the SAW. Expression (3) below expresses this relationship.

$kh2= 2\pi \cdot (ts/\lambda_M)= 5 \cdot 2\pi \cdot (ts/\lambda)$"

In addition, the graph in Fig 4 of Itakura et al. shows kh2 in the range from 1.5 to 8. According to Expression (3) above, the SiO_2 layer of Itakura et al. would have a maximum thickness when kh2 has a value of 8. In Expression (3) of Itakura et al., when kh2 has its maximum value of 8, the normalized thickness of the SiO_2 layer, ts/λ, of Itakura et al. is 0.2548. That is, the maximum normalized thickness of the SiO_2 layer, ts/λ, of Itakura et al. is 0.2548.

The normalized thickness of the SiO_2 layer, ts/λ, of Itakura et al. corresponds to the normalized thickness of the SiO_2 layer, H/λ, shown in Fig. 11 of Irino et al. As clearly shown in Fig. 11 of Irino et al., when the normalized thickness of a SiO_2 layer is 0.2548 or less, as taught by Itakura et al., no boundary acoustic wave is propagated, and instead, only a surface acoustic wave is propagated. As shown in Fig. 11 of Irino et al., the normalized thickness of the SiO_2 layer must be significantly greater than 0.2548, in order to propagate a boundary acoustic wave.

In view of the explanation above, the Examiner tentatively agreed in the Personal Interview that Itakura et al. only teaches a surface acoustic wave device, and that Itakura et al. fails to teach or suggest a boundary acoustic wave device as recited in Applicant's Claims 31 and 34.

Claims 23-28, 30, 31, and 33-57 were rejected under 35 U.S.C. §112, second paragraph, for allegedly being indefinite. Particularly, the Examiner alleged, "It is unclear what is meant by 'an outer surface'. As currently written, this language can be read as referring to any of the surfaces of the single crystal substrate, including the top, sides,

and bottom. In the case of the top surface and side surfaces the functional language recited is not accurate. Based on the specification and the drawings, it appears that this language is intended to refer to the bottom surface or the surface opposite the surface that abuts against the solid layer." Applicant has amended Claims 31 and 34 to correct the informalities noted by the Examiner. Particularly, Applicant has amended Claims 31 and 34 to the features of "the outer surface of the single crystal substrate and the outer surface of the solid layer are defined by surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer." Accordingly, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claims 23-28, 31, 33, 35-38, and 41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. (US 2002/0158549) in view of Taniguchi (U.S. 2001/0008387), Takayama et al. (U.S. 2004/0174233), and Nishiyama et al. (U.S. 2007/0132339). Claim 30 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., Nishiyama et al., and further in view of Takamine (U.S. 2002/0135267). Claims 34, 43-48, and 50 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., and Nakahata et al. (U.S. 6,025,636). Claims 39 and 40 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., Nishiyama et al., and further in view of Mishima et al. (U.S. 2005/0099091). Claim 42 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., Nishiyama et al., and further in view of Kadota et al. (U.S. 5,260,913). Claim 49 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., Nakahata et al., and Takamine. Claims 51-53 and 56 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., Nakahata et al., and Nishiyama et al. Claims 54 and 55 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al.,

Nakahata et al., Nishiyama, and Mishima et al. Claim 57 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi, Takayama et al., Nakahata, and Kadota et al. Applicant respectfully traverses the rejections of Claims 23-28, 30, 31, and 33-57.

Claim 31 has been amended to recite:

> A boundary acoustic wave device using a non-leaky propagation type boundary acoustic wave, comprising:
>
> a plurality of boundary acoustic wave elements, each boundary acoustic wave element including a single crystal substrate, a solid layer provided on the single crystal substrate, and interdigital electrodes arranged at a boundary between the single crystal substrate and the solid layer; wherein
>
> the single crystal substrates have a same cut angle;
>
> a propagation direction of a boundary acoustic wave of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements;
>
> **a thickness of the solid layer is set such that** energy of the boundary acoustic wave is not present on an outer surface of the single crystal substrate and is not present on an outer surface of the solid layer, **said outer surfaces of the single crystal substrate and the solid layer are defined by respective surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer;**
>
> a thickness of the electrodes is set so that the acoustic velocity of an SH type boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate;
>
> $H/\lambda > 8261.744\rho^{-1.376}$, when ρ (kg/m^3) represents the density of the electrodes, H represents the thickness of the electrodes, and λ represents the wavelength of a boundary wave_which is defined by a placement period of electrode fingers of the interdigital electrodes; and
>
> $\rho > 3{,}745$ kg/m^3. (emphasis added)

Applicant's Claim 34 recites feature that are similar to the features recited in Applicant's Claim 31, including the above-emphasized features.

The Examiner alleged that the combination of Itakura et al., Taniguchi, Takayama et al., and Nishiyama et al. teaches all of the features recited in Applicant's Claim 31, and that the combination of Itakura et al., Taniguchi, Takayama et al., and Nakahata teaches all of the features recited in Applicant's Claim 34. In paragraph 39 of the Response to Arguments section on page 15 of the outstanding Office Action, the Examiner acknowledged that a boundary acoustic wave device is a device that propagates an acoustic wave along an interface between two surfaces. Both Itakura et al. and Nakahata et al. disclose such devices and may therefore be considered boundary acoustic wave devices. Itakura et al. propagates an acoustic wave along the surface of the single crystal layer, which surface is defined by the boundary between the single crystal layer and the solid layer; therefore, the acoustic wave generated by the IDTs of Itakura et al. travels along the boundary between the single crystal layer and the solid layer and may therefore be considered a boundary acoustic wave device.

Although Applicant disagrees with the Examiner's allegations, in order to expedite prosecution of the present application, Applicant has amended Claims 31 and 34 to recite the features of "a thickness of the solid layer is set such that energy of the boundary acoustic wave is not present on an outer surface of the single crystal substrate and is not present on an outer surface of the solid layer" and "the outer surface of the single crystal substrate and the outer surface of the solid layer are defined by respective surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer;"

Support for these features is found, for example, in paragraph [0186] of Applicant's originally filed Substitute Specification.

As acknowledged by the Examiner in the Personal Interview of November 4, 2009 and for the reasons described above, Itakura et al. and Nakahata et al. specifically and solely disclose a <u>**surface acoustic wave device**</u> and fail to teach or suggest anything at all about a <u>**boundary acoustic wave device**</u>.

Since Itakura et al. and Nakahata et al. fail to teach or suggest any boundary acoustic wave device whatsoever, Itakura et al. and Nakahata et al. clearly fail to teach or suggest the features of “a thickness of the solid layer is set such that energy of the boundary acoustic wave is not present on an outer surface of the single crystal substrate and is not present on an outer surface of the solid layer” and “the outer surface of the single crystal substrate and the outer surface of the solid layer are defined by respective surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer” as recited in Applicant’s Claims 31 and 34.

In fact, since the devices disclosed in Itakura et al. and Nakahata et al. are **surface acoustic wave devices**, not boundary acoustic wave devices, the thickness of a solid layer would necessarily be set such that energy of the acoustic wave of each of Itakura et al. and Nakahata et al., would be present on at least one of an outer surface of a single crystal substrate and an outer surface of a solid layer, where the outer surface of the single crystal substrate and the outer surface of the solid layer are defined by surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejection of Claim 31 under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi and Takayama et al., and the rejection of Claim 34 under 35 U.S.C. § 103(a) as being unpatentable over Itakura et al. in view of Taniguchi and Takayama et al., and further in view of Nakahata.

The Examiner relied upon Takamine, Mishima et al., and Kadota et al. to allegedly cure various deficiencies of Itakura et al., Taniguchi, and Takayama et al. However, Takamine, Mishima et al. and Kadota et al. fail to teach or suggest the features of “a thickness of the solid layer is set such that energy of the boundary acoustic wave is not present on an outer surface of the single crystal substrate and is not present on an outer surface of the solid layer” and “the outer surface of the single

crystal substrate and the outer surface of the solid layer are defined by respective surfaces of the single crystal substrate and the solid layer opposite to abutting surfaces of the single crystal substrate and the solid layer" as recited in Applicant's Claims 31 and 34. Thus, Applicant respectfully submits that Takamine, Mishima et al. and Kadota et al. fail to cure the deficiencies of Itakura et al., Taniguchi, Takayama et al., Nishiyama et al., and Nakahata et al. described above.

Accordingly, Applicant respectfully submits that Itakura et al., Taniguchi, Takayama et al., Takamine, Nishiyama et al., Nakahata et al., Mishima et al. and Kadota et al., applied alone or in combination, fail to teach or suggest the unique combination and arrangement of features recited in Applicant's Claims 31 and 34.

In view of the foregoing amendments and remarks, Applicant respectfully submits that Claims 31 and 34 are allowable. Claims 23-28, 30, 33, and 36-57 depend upon Claims 31 and 34, and are therefore allowable for at least the reasons that Claims 31 and 34 are allowable.

In view of the foregoing amendments and remarks, Applicant respectfully submits that this application is in condition for allowance. Favorable consideration and prompt allowance are solicited.

The Commissioner is authorized to charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-1353.

Respectfully submitted,

Dated: November 12, 2009

/Christopher A. Bennett, #46,710/
Attorneys for Applicant

KEATING & BENNETT, LLP
1800 Alexander Bell Drive, Suite 200
Reston, VA 20191
Telephone: (571) 313-7440
Facsimile: (571) 313-7421

Joseph R. Keating
Registration No. 37,368

Christopher A. Bennett
Registration No. 46,710